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(54) Automotive pedal support structure and automotive vehicle provided therewith

(57) To avoid a steering shaft (61) changing its orientation during a frontal collision in an automotive pedal support structure equipped with an operating pedal (21) disposed behind a dash panel (11) of an automotive vehicle and the steering shaft (61) comprising a universal joint (64) disposed in the proximity of the operating pedal (21). Provided are a first bracket (3) comprising a first and second side wall portions (31, 35) and a connecting portion (36) and a second bracket pivoted to the first bracket (3) so as to be rotated during the frontal collision. The operating pedal (21) is pivoted to the second bracket (4). During the frontal collision, the universal joint (64) is longitudinally moved relatively with respect to the first bracket (3) while contacting with side surfaces of the first and second side wall portions (31, 35).

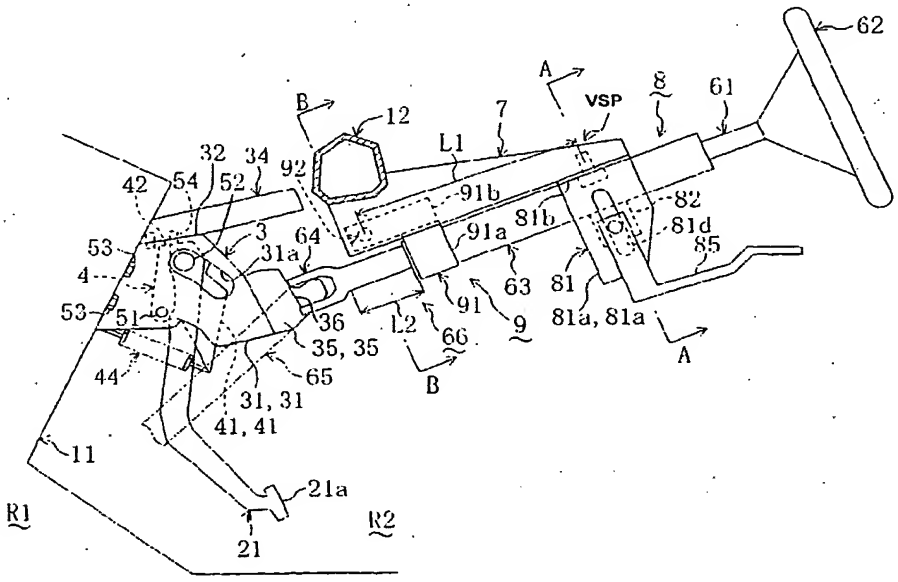

Fig. 1

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Description

[0001] This invention relates to an automotive pedal support structure equipped with an operating pedal disposed behind an automotive dash panel and a steering shaft comprising a universal joint disposed in the proximity of the operating pedal and to an automotive vehicle provided therewith.

[0002] Conventionally, this kind of pedal support structure where a bracket to which the operating pedal is pivoted is attached to a dash panel through a bucklingly transformable collar is known (See e.g. Japanese publication of patent application 10-175492). This tries to prevent the operating pedal from being thrown rearwardly by bucklingly transforming the collar during an automotive collision (frontal collision)

[0003] Since a steering shaft is disposed so as to extend in the longitudinal direction of vehicular body in the proximity of the operating pedal, a universal joint of this steering shaft may be positioned in the proximity of the operating pedal.

[0004] In this case, during a frontal collision a rearward movement of the operating pedal might cause the operating pedal to contact with the universal joint and push it and this might cause the steering shaft to incline and change its orientation. Such a steering shaft changing its orientation, e.g. in the case that an air bag is arranged at the steering wheel, might offset the deployment direction of the air bag.

[0005] Also in a steering shaft support structure with a so called tilt mechanism which allows for adjustment of the steering shaft position in the vertical direction, when the operating pedal pushes the universal joint, the steering shaft might change its orientation in the vertical direction, and particularly as described in Japanese publication of patent application 7-165088 when a pivot portion which pivots the steering shaft against the vehicular body member is provided in the front position of this steering shaft, the steering shaft might greatly change its orientation.

[0006] This invention is made considering these circumstances, and its object is to avoid a steering shaft changing its orientation during a frontal collision in an automotive pedal support structure equipped with an operating pedal disposed behind a dash panel of an automotive vehicle and a steering shaft comprising a universal joint disposed in the proximity of the operating pedal.

[0007] This object is solved according to the invention by an automotive pedal support structure according to claim 1 and by an automotive vehicle according to claim 9. Preferred embodiments of the invention are defined in the dependent claims.

[0008] To achieve the above object, this invention has avoided the interference between the operating pedal and the steering shaft.

[0009] According to the invention, an automotive pedal support structure is provided which is equipped with an operating pedal disposed or disposable behind a dash panel of an automotive vehicle and a steering shaft comprising a universal joint disposed or disposable in the proximity of said operating pedal.

[0010] Further the automotive pedal support structure is equipped with a first bracket with at least one side wall portion attached or attachable to the dash panel so as to extend rearwardly, places or can place the operating pedal in front of the universal joint and pivots the operating pedal to the first bracket oppositely to the universal joint with respect to the first bracket.

[0011] Further, the automotive pedal support structure is constituted so that during an automotive frontal collision the universal joint relatively moves to the first bracket in the longitudinal direction while contacting with a side surface of the side wall portion of first bracket accompanied with the rearward movement of the dash panel.

[0012] Accordingly, when during the frontal collision the first bracket and the operating pedal pivoted to the first bracket move rearwardly, the universal joint moves relatively to the first bracket along the side surface of the side wall portion in the longitudinal direction while contacting with the side wall portion of the first bracket.

[0013] At this time, since the operating pedal is disposed oppositely to the universal joint with respect to the side wall portion, the interference between the operating pedal and the universal joint is prevented by the side wall portion. Further, since the universal joint moves sliding on the side surface of the side wall portion, this universal joint will not be pushed in the longitudinal or the vehicular width directions. Accordingly, the steering shaft changing its orientation is certainly avoided.

[0014] Accordingly, since the interference itself between the operating pedal and the universal joint is avoided as well as the universal joint being pushed, the change of the steering shaft orientation during the frontal collision is certainly avoided, even in the case of a steering shaft support structure with a tilt mechanism or even if a pivot portion is provided in the front position of the steering shaft.

[0015] According to a preferred embodiment of the invention, the first bracket is equipped with a pair of side wall portions which are spaced apart with each other in the vehicular width direction and at least one connecting portion which connects the pair of side walls with each other in the vehicular width direction.

[0016] Further, the operating pedal is pivoted to the first bracket between the pair of side walls and the universal joint being positioned or positionable oppositely to the operating pedal with respect to either one of the side wall portions of first bracket.

[0017] This relates to the fact that when the side wall portion is deformed due to the contact of the universal joint with the side wall portion of first bracket, the operating pedal might interfere with the universal joint.

[0018] Then, by connecting the pair of side wall por-

tions with each other, which are spaced apart with each other in the vehicular width direction, using the connecting portion, a rigidity of the side wall portions in the vehicular width direction is increased. Then, the deformation of the side wall portions is prevented when the universal joint contacts with the first bracket. Thereby, the universal joint will relatively move more certainly along the side surface of the side wall portions, which results that the interference between the operating pedal and the universal joint is more certainly prevented and that the steering shaft changing its orientation is more certainly prevented.

[0019] Further preferably, a second bracket is provided a front end lower portion of which is pivoted to the first bracket and an upper portion of which is detachably attached to the vehicle body member by rearwardly moving during the automotive frontal collision.

[0020] Further the operating pedal is pivoted to the second bracket.

[0021] Accordingly, since normally the front end lower portion of second bracket is pivoted to the first bracket while the upper portion is attached to the vehicular body side member, the second bracket will be integrated with the first bracket and the stepping operation of the operating pedal rotatably pivoted to the second bracket will be enabled.

[0022] In contrast with this, when the dash panel moves rearwardly during the frontal collision, the first bracket attached to this dash panel, the operating pedal and the second bracket which supports the operating pedal will move together rearwardly, the upper portion of this second bracket will be released from the body side member due to the rearward movement of the second bracket and the second bracket will be in a cantilever fashion where it is supported with its front end lower portion by the first bracket. At this time the second bracket in the cantilever fashion will be released from the vehicular body member while rotating rearwardly around a pivoting point of the front end lower portion as a rotation center along with the operating pedal, thereby the operating pedal rotates to move a lower pedal portion forwardly. Since in this manner the rearward movement of the operating pedal is avoided, the interference between the operating pedal and the universal joint is more certainly avoided.

[0023] Still further preferably, the automotive pedal support structure is provided which is equipped with an operating pedal arranged behind a dash panel of an automotive vehicle and a steering shaft comprising a universal joint arranged in the proximity of said operating pedal.

[0024] Most preferably, the automotive pedal support structure further comprises a support portion having a first engaging portion for engaging an intermediate portion of a steering column of the steering shaft and an arm portion extending forwardly along the shaft axis direction, wherein the pivot point is provided on the arm portion.

[0025] Then, it comprises a pivot portion which pivots the steering shaft with respect to a vehicular body member at a front position of the steering shaft and a variable support portion which supports the steering shaft variably in its position in substantially vertical direction with respect to the vehicular body member at its rear position and it comprises a first bracket having a side wall portion attached to the dash panel so as to extend rearwardly, and a second bracket with its front end lower portion being pivoted to the first bracket and its upper portion being attached to a vehicular body member so that it moves rearwardly to be released from the vehicle body side member during an automotive frontal collision.

[0026] The operating pedal is rotatably pivoted to the second bracket so as to be positioned between the pair of side wall portions of first bracket and the universal joint being positioned oppositely to the operating pedal with respect to either one of the side wall portions of first bracket.

[0027] Then, the universal joint is constructed so that during an automotive frontal collision the universal joint can move in the longitudinal direction relative to the first bracket while contacting with the side wall portion of first bracket due to a rearward movement of the dash panel during an automotive frontal collision.

[0028] Accordingly, the similar function and effect to those of the first through third aspects can be obtained. Accordingly, since the interference itself between the operating pedal and the universal joint is avoided as well as the universal joint being pushed, the change of steering shaft orientation is certainly avoided during the frontal collision even if the pivot portion is provided in the front position of steering shaft.

[0029] As explained above, according to the automotive pedal support structure of this invention, the interference between the operating pedal and the steering shaft during the frontal collision can be avoided since the universal joint moves relatively to the first bracket in the longitudinal direction while contacting with the side surface of side wall portions of the first bracket.

[0030] Also this invention can more certainly avoid the interference between the operating pedal and the universal joint, since the operating pedal is rotated so that the lower pedal portion moves forwardly during the frontal collision by pivoting the operating pedal to the second bracket.

[0031] Accordingly, it can be certainly avoided that the universal joint of the steering shaft being pushed inadequately directs the steering shaft orientation during the frontal collision.

[0032] According to a further preferred embodiment of the invention, the automotive pedal support structure further comprises a steering bracket mountable or mounted to an instrument panel member of the vehicle for supporting the steering shaft, wherein a portion of the steering bracket comprises an interference preventing portion for preventing an interference of the first bracket and the steering bracket in the case of a frontal

collision.

[0033] Preferably, the steering bracket comprises a pair of reinforcement portions, the interference preventing portion comprising a cutout portion provided at least in one of the reinforcement portions.

[0034] Most preferably, the operating pedal is biased by at least one biasing means to be rearwardly inclined in case of an automotive frontal collision.

[0035] According to the invention, there is further provided an automotive vehicle having at least one pedal support structure equipped with an operating pedal according to the invention or an embodiment thereof disposed behind a dash panel of an automotive vehicle and a steering shaft comprising a universal joint disposed in the proximity of said operating pedal, whereinthe first bracket having the at least one side wall portion is mounted to said dash panel so as to extend rearwardly;

said operating pedal is positioned in front of said universal joint and is rotatably pivoted to said first bracket oppositely to said universal joint with respect to said first bracket; and

said universal joint is arranged so that during an automotive frontal collision said universal joint moves in the longitudinal direction relatively to said first bracket while contacting with said side wall portion of first bracket accompanied with a rearward movement of said dash panel.

[0036] The invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a side view illustrating an overall construction of an embodiment of this invention;

Figure 2 is a plan view illustrating the overall construction of the embodiment of this invention;

Figure 3 is side view illustrating an enlarged pedal support structure portion;

Figure 4 is a plan view schematically illustrating a attachment structure of an upper portion of both the brackets;

Figure 5 is a sectional view illustrating an A-A section of Figure 1;

Figure 6 is a sectional view illustrating a B-B section of Figure 1;

Figure 7 is a side view illustrating a condition during an automotive collision corresponding to Figure 1; and

Figure 8 is a plan view illustrating a condition during an automotive collision corresponding to Figure 2.

[0037] Embodiments of this invention will be described with reference to the above described drawings.

[0038] Figures 1 and 2 show an overall arrangement of a preferred embodiment of the invention wherein a dash panel 11 constitutes of a part of a vehicular body of an automotive vehicle in front of which (in the left side of the figures) an engine compartment R1 where an engine (not shown) is received and in the rear part of which (in the right side of the figures) a passenger compartment R2 are respectively sectioned and formed. In the passenger compartment R2, an instrument panel member 12 is disposed substantially extending in the vehicular width direction or the width direction of the vehicle and this instrument panel member 12 is part of a vehicular body member with a structure which does not move rearwardly so as to assure passenger space within the passenger compartment R2 during a frontal collision.

[0039] Then behind the lower portion of the dash panel 11, which is a front end portion of a lower portion of the passenger compartment R2, a brake pedal 21 is disposed as an operating pedal which is stepped and operated by a driver sitting on a driver seat (not shown). Also in a position offset in the vehicular width direction with respect to this brake pedal 21, a steering shaft 61 is disposed which extends at an angle different from 0° or 180° or which has a bent form from the rear upper side to the front lower side. Further in Figure 2, an illustration of the brake pedal is omitted.

[0040] Firstly explaining the arrangement of the brake pedal 21 with reference to Figures 1 through 4, a first bracket 3 is affixed to a rear surface of the lower portion of the dash panel 11 with bolt members 53, 53 i.e. at a side of the passenger compartment R2 of the dash panel 11.

[0041] This first bracket 3 comprises a pair of substantially plate-shaped first side wall portions 31, 31 attached or affixed to the dash panel 11 so as to extend rearwardly therefrom i.e. towards the passenger compartment R2. This pair of first side wall portions 31, 31 are attached so as to be separated from each other and substantially parallel to each other in the vehicular width direction.

[0042] In the upper end portion at the substantially center position in the longitudinal direction of this pair of first side wall portions 31, 31, an upper wall portion 32 is provided which substantially extends in the vehicular width direction to connect the both of first side wall portions 31, 31. In the upper side of this upper wall portion 32, a fixing member 34 as a vehicular body member is attached with a fastening bolt 54. This fixing member 34 is disposed extending rearwardly so as to direct it toward the instrument panel member 12 disposed extending in the vehicular width direction. Also in the upper wall portion 32, as enlarged and illustrated in Figure 4, an elongated aperture 33 is formed which has a smaller width than an outer diameter of a head portion 54a of the fastening bolt 54 and substantially extends in the longitudinal direction of the upper wall portion 32 or towards and away from the passenger compartment R2.

[0043] In the rear upper portions of respective first wall portions 31, window portions 31a are formed extending substantially arcuately from the front upper portion to the rear lower portion. In this window portion 31a, a pedal support shaft 52 is disposed which will be de-

scribed later.

[0044] Then in rear ends of the pair of first side wall portions 31, a pair of second side wall portions 35 are provided extending rearwardly so as to approach each other or converge. The rear ends of these second side wall portions 35 are at a substantially same position in the longitudinal direction as a universal joint 64 of the steering shaft 61. The rear end portions of this pair of second wall portions 35 are connected by a connecting portion 36 substantially extending in the vehicular width direction, whereby rigidity of the first and second side wall portions 31, 35 in the vehicular width direction is improved. The first and second side wall portions 31, 35 construct the side wall portion of the first bracket 3.

[0045] Between the pair of first side wall portions 31, 31 of the first bracket 3, a second bracket 4 is disposed so as to be at least partly overlapped with the first side wall portions 31 as seen from the vehicular width direction.

[0046] This second bracket 4, similarly to the first bracket 3, comprises a pair of side wall portions 41, 41 spaced with each other in the vehicular width direction and an upper wall portion 42 connecting the upper end portions of this pair of side wall portions 41, 41 with each other and it has a reverse U-shaped section downwardly opening.

[0047] A front end lower portion of the side wall portion 41 is pivoted or pivotably connected to a center lower portion of the first side wall portion 31 of the first bracket 3 with a caulking pin 51. On the other hand, the upper wall portion 42 of the second bracket 4 is mounted to the fixing member 34 so as to move rearwardly to be mechanically released during the automotive frontal collision.

[0048] That is, the upper wall portion 42 of the second bracket 4 is positioned so as to be overlapped with the lower side of the upper wall portion 32 of the first bracket 3. In the upper wall portion 42 of this second bracket 4, an elongated aperture 43 extending in the longitudinal direction of the automotive vehivle or of the second bracket 4 is formed as enlarged and illustrated in Figure 4. Being different from the elongated aperture 33 of the first bracket 3, this elongated aperture 43 comprises a narrower portion 43a which is positioned in the rear end portion and has a smaller width than an outer diameter of the head portion 54a of the fastening bolt 54 and a wider portion 43b which continues in front of or is continuous with this narrower portion 43a and has a larger width than an outer diameter of the head portion 54a of the fastening bolt 54. By substantially aligning the narrower portion 43a at the rear end of this elongated aperture 43 with the rear end portion of 33a of the elongated aperture 33 of the first bracket 3, inserting the fastening bolt 54 into the narrower portion 43a and the rear end portion 33a and fastening them to the fixing member 34, the upper portion of the second bracket 4 is fixedly mounted to the fixing member 34 along with the upper portion of the first bracket 3. And when the second bracket 4 moves rearwardly with the first bracket 3 during the frontal collision, the upper portion of the first bracket 3 is not released from the fixing member 34 while only the fastening bolt 54 relatively moves forwardly from the rear end portion 33a, but in the upper portion of the second bracket 4, as shown with two-dot chain line in Figure 4, the fastening bolt 54 relatively moves from the narrower portion 43a of the rear end to the frontal wider portion 43b. At this wider portion 43b, the head portion 54a of the fastening bolt 54 will or can pass out. By this, the upper portion of the second bracket 4 is attached to the fixing member 34 so that it rearwardly moves to be released during the automotive frontal collision.

[0049] Then, between the side wall portions 41, 41 in the proximity of the upper end portion of the second bracket 4, the pedal support shaft 52 is spanned extending in the vehicular width direction. To this pedal support shaft 52 an upper end portion of the brake pedal 21 is rotatably or pivotably attached. This brake pedal 21 substantially is elongated plate-shaped and at its lower end portion a pedal portion 21a is provided which a driver puts his foot on and steps down. Further, lateral end portions of the pedal support shaft 52 is displaced to protrude into the window portions 31a of the first bracket 3.

[0050] Also to the lower rear end portion of the second bracket 4 one end of a coil spring 44 is affixed while the other end of this coil spring 44 is affixed to the front end portion of the first bracket 3. This coil spring 44 is normally (in the condition shown in Figure 1) in a tensioned condition.

[0051] Although not being illustrated, an operating rod which is connected through a master back to a master cylinder of a brake apparatus positioned in a rear end portion of the engine compartment R1 is connected to a middle portion of the brake pedal 21. When this brake pedal 21 is rotated in the clockwise direction in Figure 1 by stepping the pedal portion 21a of the brake pedal 21, the pedal forwardly pushes the operating rod to actuate the master back. Then, the master cylinder actuates the brake while the master back increases the pressured force against the master cylinder.

[0052] Next describing an arrangement structure of the steering shaft 61 with reference to Figures 1, 2, 5 and 6, a steering wheel 62 is attached to a rear end portion of the steering shaft 61. Also, the steering shaft 61 is borne by a steering column 63.

[0053] A universal joint 64 is provided at the lower end in a shaft axis direction of the steering shaft 61. Through this universal joint 64, the steering shaft 61 and a middle shaft 65 are connected with each other. Accordingly, the brake pedal is positioned in front of the universal joint 64 and oppositely to the universal joint 64 with respect to the first and second wall portions 31, 35 of the first bracket 3. Further, the lower end of this middle shaft 65 is connected to a steering gear box not shown.

[0054] In a front section of the steering column 63, a collapse portion 66 is provided which absorbs energy

applied in the shaft axis direction. This collapse portion 66 is constituted by a part of an inner tube being inserted into an outer tube and arranged so that a predetermined load input causes the inner tube to insert into the outer tube. The length of this collapse portion 66 in the shaft axis direction, that is a collapsing area of the collapse portion 66, is set L2.

[0055] The steering column 63 is supported by a steering bracket 7 affixed to a lower portion of the instrument panel member 12 e.g. by welding. This steering bracket 7 is disposed so as to extend rearwardly and upwardly at an angle different from 0° or 180° from the instrument panel member 12.

[0056] The steering bracket 7, as shown in Figures 5 and 6, is formed into a substantially W-shaped section with a center wall portion 71 extending in the vehicular longitudinal direction and side reinforcement portions 72, 73. Also a cutout portion 74 is provided at a front end section of the side reinforcement portion 73 where the brake pedal 21 is disposed (see Figures 2 and 6). As described later, this cutout portion 74 will prevent an interference between the steering bracket 7 and the first bracket 3 during the frontal collision.

[0057] The steering column 63 is supported to the steering bracket 7 at a rear support portion 8 in its rear position and at a front support portion 9 in its front position. The rear support portion 8 is made as or corresponds to a variable support portion or point VSP which supports the steering column 63 (steering shaft 61) variably in its position in the substantially vertical direction with respect to the steering bracket 7 while the front support portion 9 is made as or corresponds to a pivot portion which pivots the steering column 63 against the steering bracket 7.

[0058] The rear support portion 8, as shown in Figures 1, 2 and 5, is provided with a support member which is formed into a reverse hat-shaped section by a pair of vertical walls 81a, 81a spaced with each other in the vehicular width direction and substantially spread or extending in the vertical direction and attachment portions 81b substantially spread or extending in the horizontal direction from upper end portions of the respective vertical wall portions 81a.

[0059] At the respective attachment portions 81b a concave groove or opening 81c is formed opening toward its rear end and forwardly extending. A fastening bolt 55 is inserted through a front portion of this concave groove 81c. The attachment portions 81b, 81b are respectively affixed to the side reinforcement portions 72, 73 of the steering bracket 7.

[0060] At the each vertical wall portion 81a, a guide groove 81d is formed extending vertically in a substantially center position of its longitudinal direction. Also between this pair of vertical wall portions 81a, 81a, the steering column 63 is inserted or insertable. To a lower portion of the steering column 63 which is positioned between these vertical wall portions 81a, 81a, a sliding member 82 of approximately rectangular section is affixed such as by welding. This sliding member 82 is allowed to slide in the vertical direction between the pair of vertical wall portions 81a, 81a. At opposite side wall portions of the sliding member 82, penetrating apertures are formed. Into the guide groove 81d and the penetrating apertures, a fastening bolt 83 extending in the vehicular width direction is inserted. A head portion 83a of this fastening bolt 83 is affixed to or abuts on an outer surface of one of the vertical wall portions 81a of the support member 81 while the other end portion of the fastening bolt 83 protrudes out of the other one of the side wall portions 81a and is screwed to a nut member 84. An operating lever 85 is integrally or unitarily affixed to this nut member 84. This operating lever 85 is fixed by a stopper nut 86 provided outside of the nut member 84.

[0061] The nut member 84 is tightened to the fastening bolt 83 by rotating or pivoting the operating lever 85 in a first or positive direction, then the sliding member 82 becomes in a locked condition where it is sandwiched by the vertical wall portions 81a, 81a of the support member 81. This causes the steering column 63 to be fixed at a predetermined position. On the other hand by rotating the operating lever 85 in a second or negative direction being opposed to the first or positive direction, the nut member 84 is loosened against the fastening bolt 83 to be in an unlocked condition. This enables the fastening bolt 83 to move substantially vertically along the guide groove 81d and allows for the positioning adjustment of the steering column 63.

[0062] The front support portion 9, as shown in Figures 1, 2 and 6, has a pivot member 91 comprised of a gripping or engaging portion 91a gripping or engaging an intermediate portion of the steering column 63 and an arm portion 91b affixed to an upper portion of this gripping portion 91a and extending forwardly along the shaft axis direction.

[0063] The arm portion 91b of this pivot member 91 is positioned under the center wall portion 71 of the steering bracket 7 and between the pair of side reinforcement portions 72, 73 and its front end portion is pivoted against a side wall of each of the side reinforcement portion 72, 73 by a pivot shaft 92 extending in the vehicular width direction. Since in such a manner the arm portion 91b is arranged to extend forwardly along the shaft axis direction, a distance L1 between a pivot point (92) and a variable support portion or point (VSP) of the steering column 63 (see Figure 1) is elongated. Since this makes a tiltable angular range of the steering column 63 (steering shaft 61) smaller, a variation of steering torque in case of the position of the steering wheel 62 being changed can be decreased. Vibration of the steering wheel 62 transmitted through the steering shaft 61 can also be decreased.

[0064] Further since the distance L1 between the pivot point and the variable support point VSP is elongated by extending the arm portion 91b along the shaft axis direction, the gripping portion 91a of the pivot member

91 can be positioned at the intermediate portion of the steering column 63. This can make a distance L2 of the collapse portion 66 positioned in front of the gripping portion 66 longer. Accordingly, energy absorbing effect of the collapse portion 66 can be improved.

[0065] Function of the aforementioned embodiment will be described below. In a normal condition where the automotive vehicle does not collide, as shown with solid lines in Figures 1 and 3, the front end lower portion of the second bracket 4 is pivoted to the center lower portion of the first bracket 3 with the caulking pin 51. On the other hand, the upper portion of the second bracket 4 is tightened along with the upper portion of the first bracket 3 with the fastening bolt 54 to be affixed to the fixing member 34.

[0066] Particularly, as being illustrated with solid lines in Figure 4, the narrower portion 43a of the rear end of the elongated aperture 43 at the second bracket 4 is aligned with the rear end portion 33a of the elongated aperture 33 at the first bracket 3, the fastening bolt 54 is inserted into both of them and this fastening bolt 54 is tightened to the fastening member 34. According to this, the second bracket 4 is affixed to be unable to travel at both of the front end lower portion and upper portion, then a similar action to the normal one will be made when the driver steps to operate the brake pedal 21 during the automotive braking.

[0067] In contrast with this, when the automotive vehicle collides (during the frontal collision), the dash panel moves rearwardly and the first bracket 3 affixed to this dash panel moves rearwardly along with the second bracket 4.

At this time, since the instrument panel member 12 does not move rearwardly and remains standing still in order to assure passenger space within the passenger compartment R2 despite the automotive collision, accompanied with the first and second brackets 3, 4 moving rearwardly, a rear end of the fixing member 34 contacts with the instrument panel member 12. On the other hand, the dash panel 11 causes the first and second brackets 3, 4 to continue moving, then only the fastening bolt 54, as shown with two-dot chain lines in Figure 4, relatively moves forwardly from the rear end portion 33a within the elongated aperture 33 of the upper portion of the first bracket 3 and this upper portion of first bracket is in a fixed condition to the fixing member 34. But in the upper portion of the second bracket 4, the fastening bolt 54 relatively moves from the rear end narrower portion 43a to the front wider portion 43b within the elongated aperture 43, then the head portion 54a of the fastening bolt 54 passes out at the wider portion 43b.

This causes the attachment of only the upper portion of the second bracket 4 to be released among both of the bracket 3, 4, the upper portion is released away from the fixing member 34 and the first bracket 3, then the second bracket 4 becomes in a cantilever fashion where it is supported by the first bracket 3 only at the front end lower portion. In this condition, spring force of the coil spring 44, as illustrated by an arrow in Figure 3, causes the second bracket 4 in the cantilever condition to fall down from the instrument panel member while rotating rearwardly around a pivot point of the front end lower portion against the first bracket 3 along with the brake pedal 21. As a result of that, the brake pedal 21 is rearwardly inclined so that the pedal portion 21a at its lower portion moves forwardly (see one-dot chain lines in Figure 3).

[0068] On the other hand, when the first bracket 3 moves rearwardly, the universal joint firstly contacts with the second side wall portion 35 and relatively moves with respect to the first bracket in the longitudinal direction along the side surface of this second side wall portion 35 (see an arrow of Figure 2). After that the universal joint further relatively moves along this side surface of the first side wall portion 31 while contacting with the first side wall portion 31. Because of this, the interference between the brake pedal 21, which is disposed oppositely to the universal joint 64 with respect to the first side wall portion 31, and the universal joint 64 is prevented by the first and second side wall portions 31, 35 (see Figures 7 and 8).

[0069] Further since the universal joint 64 moves slidingly along the side surfaces of the first and second side wall portions 31, 35, this universal joint 64 is not pushed in the longitudinal direction or in the vehicular width direction.

[0070] Accordingly, the steering shaft 61 changing its orientation can be certainly avoided.

[0071] Further since the first bracket is provided with the connecting portion 36, the rigidity of the first and second wall portions 31, 35 in the vehicular width direction can be increased. Because of this, even if the universal joint contacts with the first and second side wall portions 31, 35, these are not deformed, then this universal joint can certainly slide along the side surfaces of the first and second side wall portions 31, 35. As a result of that, the interference between the brake pedal 21 and the universal joint 64 can be certainly avoided and the falling movement of the brake pedal 21 can be certainly made.

[0072] Further since the cutout portion 74 is formed at the side reinforcement portion 73 of the steering bracket 7, even if the first bracket 3 moves rearwardly, the interference between the steering bracket 7 and the first bracket 3 is avoided.

[0073] Because of this, a disadvantage accompanying with the interference between the steering bracket 7 and the first bracket 3, such as a failure of the brake pedal 21 falling down due to the deformation of the first bracket 3, can be avoided.

[0074] Further although the collapse portion 66 is collapsed by the application of load to the steering shaft 61 in the shaft axis direction due to a secondary collision, the energy is effectively absorbed because of the length L2 of the collapse portion 66 as described above.

[0075] In this way, the interference between the brake pedal 21 and the universal joint 64 can be certainly

avoided and the universal joint 64 being pushed can also be certainly avoided. Because of this, even though in a steering support structure where the orientation of the steering shaft 61 is likely to change during the frontal collision, steering shaft 61 changing its orientation can be certainly be avoided.

[0076] Although in the above described embodiment the first bracket 3 comprises the pair of first side wall portions 31, 31 and the pair of second side wall portions 35, 35, the first bracket 3 might be what comprises at least a side wall portion disposed between the brake pedal 21 and the universal joint 64.

[0077] Also, the operating pedal is not limited to the brake pedal 21, but this invention can be applied to other operating pedals.

[0078] Thus, it is proposed to avoid a steering shaft 61 changing its orientation during a frontal collision in an automotive pedal support structure equipped with an operating pedal 21 disposed behind a dash panel 11 of an automotive vehicle and the steering shaft 61 comprising a universal joint 64 disposed in the proximity of the operating pedal 21. Provided are a first bracket 3 comprising a first and second side wall portions 31, 35 and a connecting portion 36 and a second bracket pivoted to the first bracket 3 so as to be rotated during the frontal collision. The operating pedal 21 is pivoted to the second bracket 4. During the frontal collision, the universal joint 64 is longitudinally moved relatively with respect to the first bracket 3 while contacting with side surfaces of the first and second side wall portions 31, 35.

List of Reference Numerals

[0079]

3: First bracket
4: Second bracket
8: Rear support portion (Variable support portion)
9: Front support portion (Pivot portion)
11: Dash panel
21: Brake pedal (Operating pedal)
31: First side wall portion (Side wall portion of first bracket)
35: Second side wall portion (Side wall portion of first bracket)
36: Connecting portion
61: Steering shaft
63: Steering column
64: Universal joint

Claims

1. An automotive pedal support structure equipped with an operating pedal (21) disposable behind a dash panel (11) of an automotive vehicle and in the proximity of a steering shaft (61) having a universal joint (64), comprising a first bracket (3) having at least one side wall portion (31; 35) mountable to said dash panel (11) so as to extend rearwardly;

   said operating pedal (21) being positionable in front of said universal joint (64) and rotatably pivoted to said first bracket (3) oppositely to said universal joint (64) with respect to said first bracket (3); and
   said universal joint (64) being arranged so that during an automotive frontal collision said universal joint (64) moves in the longitudinal direction relatively to said first bracket (3) while contacting with said side wall portion (31, 35) of first bracket accompanied with a rearward movement of said dash panel (11).

2. An automotive pedal support structure of claim 1, wherein said first bracket (21) comprising a pair of side wall portions (31, 35) spaced apart with each other in the vehicular width direction and at least one connecting portion (32; 36) which connects said pair of side walls (31, 35) in the vehicular width direction,

   said operating pedal (21) being rotatably pivoted to said first bracket (3) between said pair of side wall portions (31, 35), and
   said universal joint (64) being positionable oppositely to said operating pedal (21) with respect to either one of said side walls (31, 35) of said first bracket (3).

3. An automotive pedal support structure as claimed in any one of the preceding claims, comprising:

   a second bracket (4) with its front end lower portion being pivoted to said first bracket and its upper portion being detachably attached to a vehicular body member (32) so as to move rearwardly during an automotive frontal collision; and
   said operating pedal (21) being pivoted to said second bracket (4).

4. An automotive pedal support structure as claimed in any one of the preceding claims, further comprising

   a pivot portion (92) which can pivot said steering shaft (61) with respect to a vehicular body member at a front position of said steering shaft (61) and
   a variable support portion (81, VSP) which can support said steering shaft (61) variably in its position in the substantially vertical direction with respect to said vehicular body member at a rear position of said steering shaft (61).

5. An automotive pedal support structure of claim 4, further comprising a support portion (9) having a first engaging portion (91a) for engaging an intermediate portion of a steering column (63) of the steering shaft (61) and an arm portion (91b) extending forwardly along the shaft axis direction, wherein the pivot point (92) is provided on the arm portion (91b).

6. An automotive pedal support structure as claimed in any one of the preceding claims, further comprising a steering bracket (7) mountable to an instrument panel member (12) of the vehicle for supporting the steering shaft (61), wherein a portion (73) of the steering bracket (7) comprises an interference preventing portion (74) for preventing an interference of the first bracket (3) and the steering bracket (7) in the case of a frontal collision.

7. An automotive pedal support structure of claim 6, wherein the steering bracket (7) comprises a pair of reinforcement portions (72, 73), the interference preventing portion (74) comprising a cutout portion (74) provided at least in one (73) of the reinforcement portions (72, 73).

8. An automotive pedal support structure as claimed in any one of the preceding claims, wherein the operating pedal (21) is biased by at least one biasing means (44) to be rearwardly inclined in case of an automotive frontal collision.

9. An automotive vehicle having at least one pedal support structure equipped with an operating pedal (21) according to one of the preceding claims disposed behind a dash panel (11) of an automotive vehicle and a steering shaft (61) comprising a universal joint (64) disposed in the proximity of said operating pedal (21), whereinthe first bracket (3) having the at least one side wall portion (31; 35) is mounted to said dash panel (11) so as to extend rearwardly;

said operating pedal (21) is positioned in front of said universal joint (64) and is rotatably pivoted to said first bracket (3) oppositely to said universal joint (64) with respect to said first bracket (3); and
said universal joint (64) is arranged so that during an automotive frontal collision said universal joint (64) moves in the longitudinal direction relatively to said first bracket (3) while contacting with said side wall portion (31; 35) of first bracket accompanied with a rearward movement of said dash panel (11).

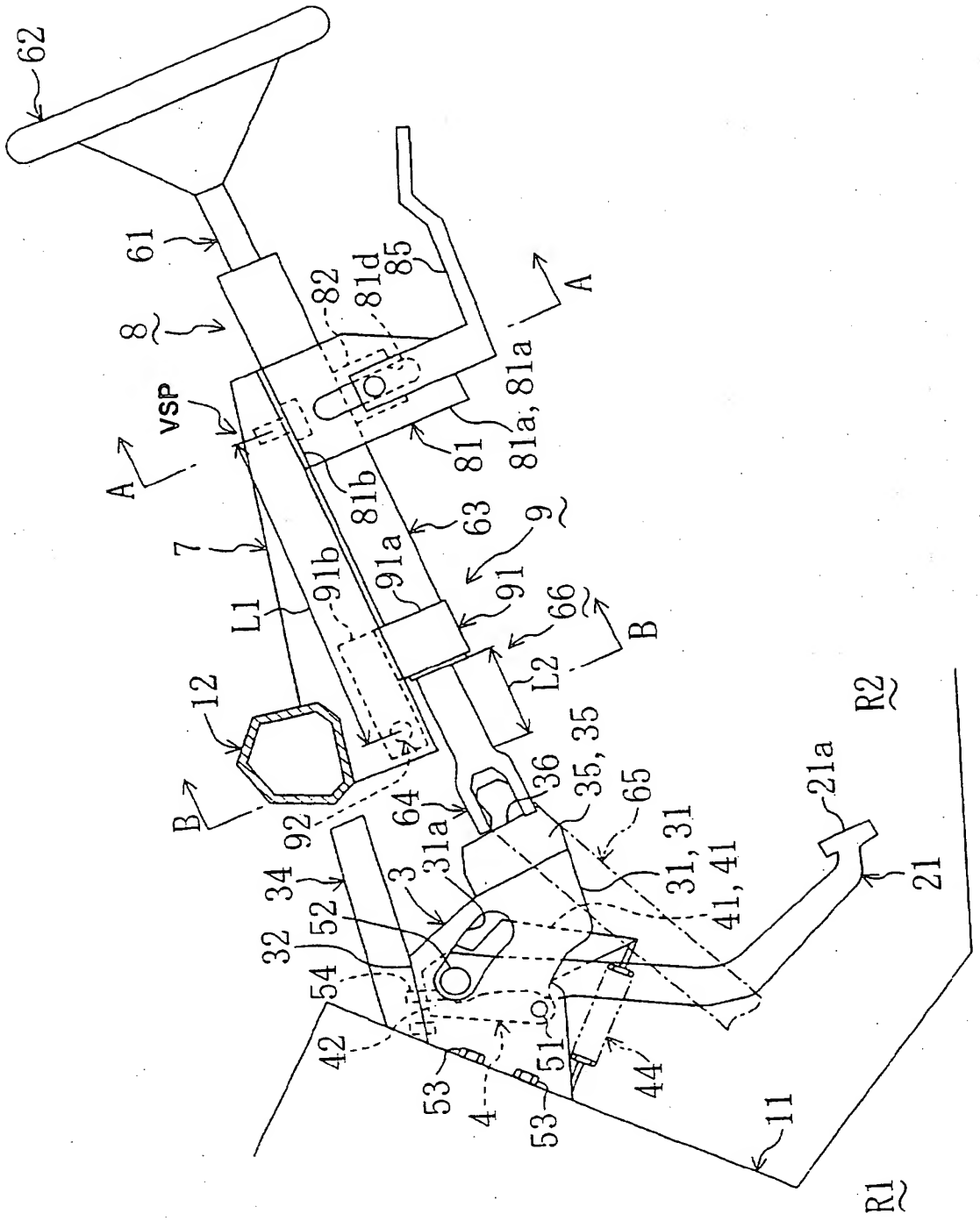

Fig. 1

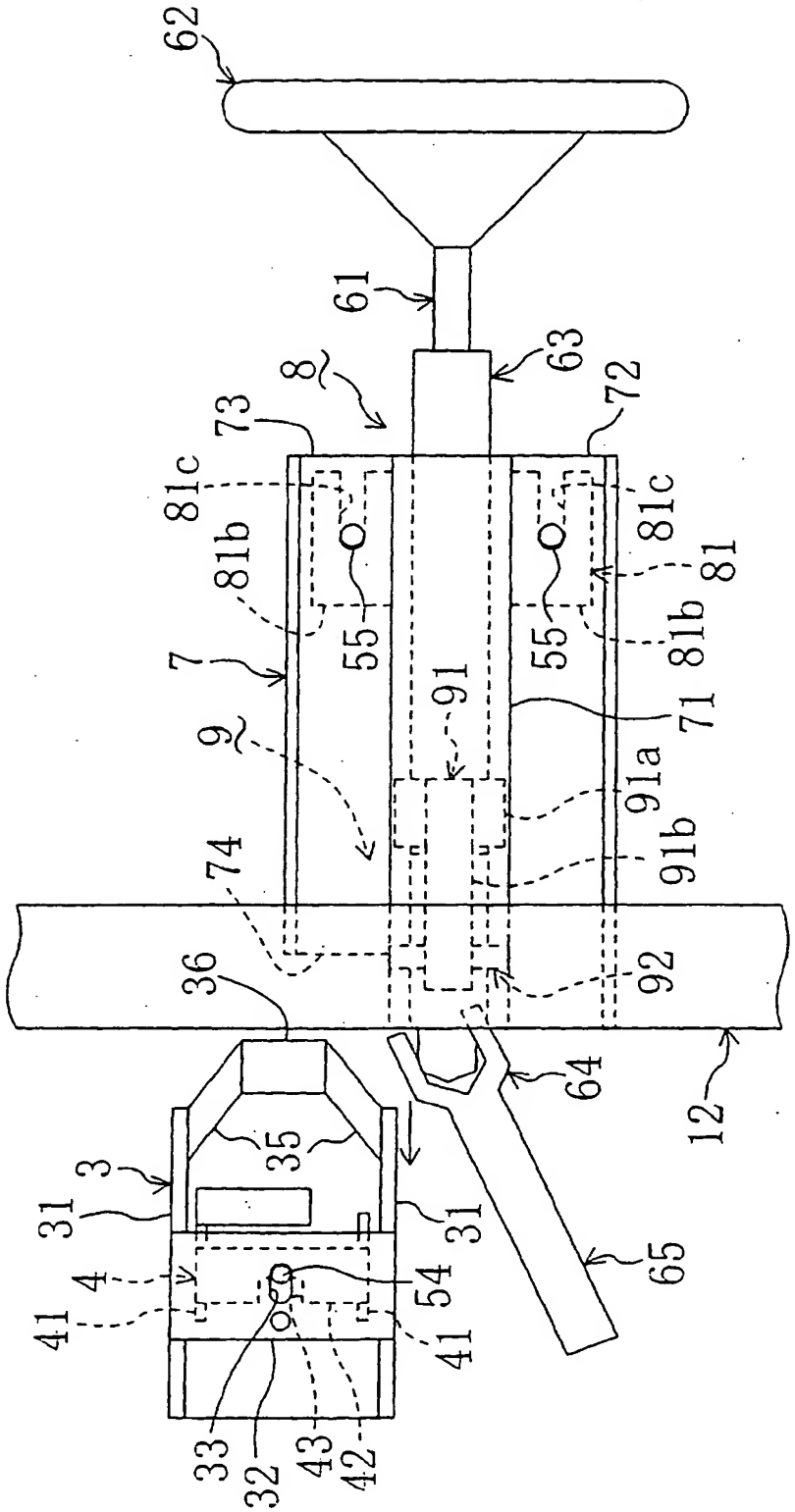

Fig. 2

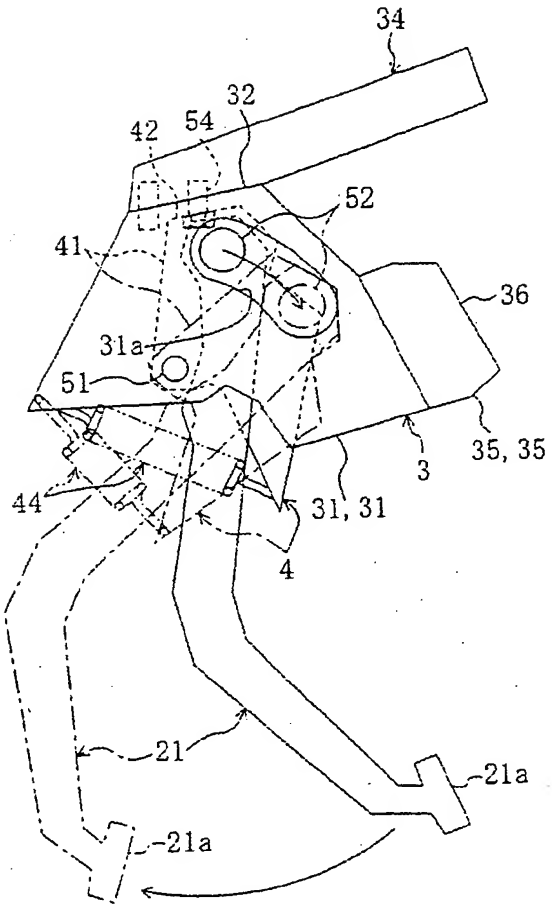

Fig. 3

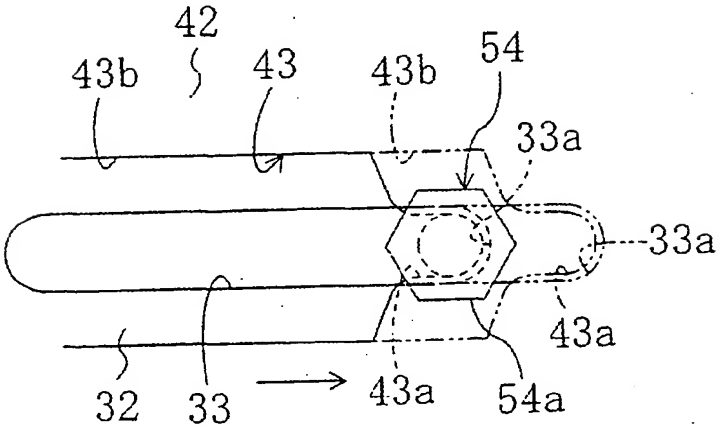

Fig. 4

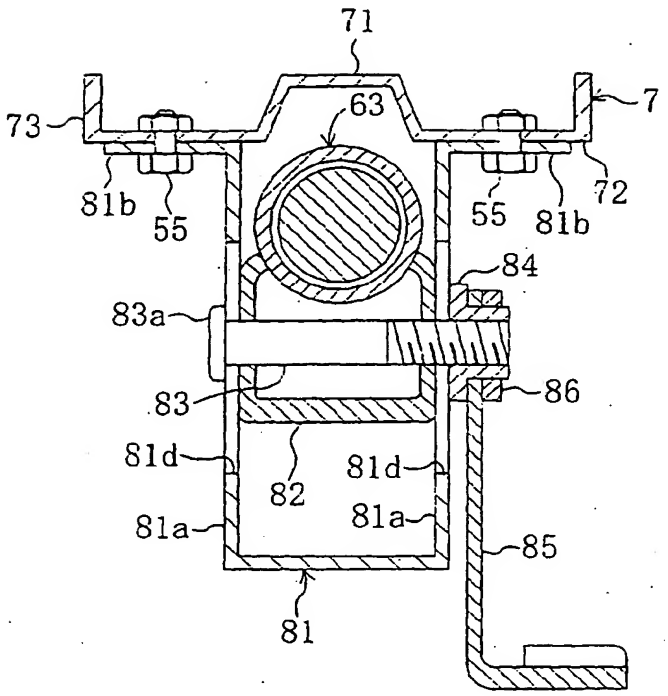

Fig. 5

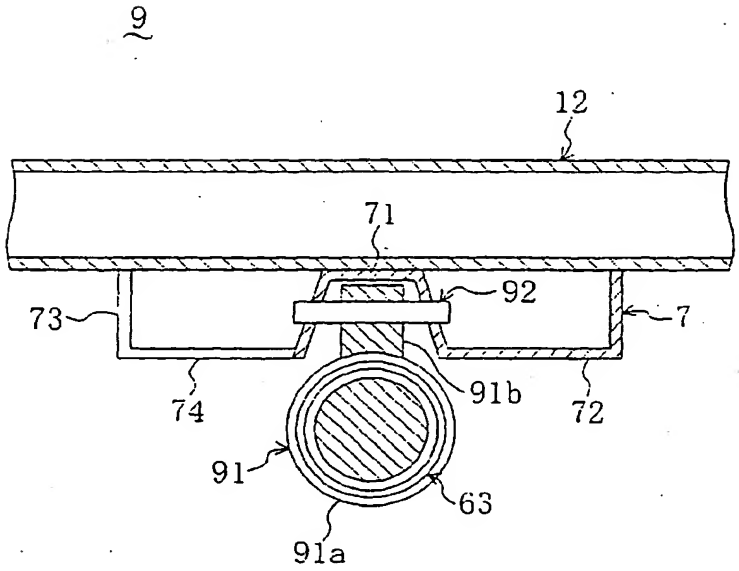

Fig. 6

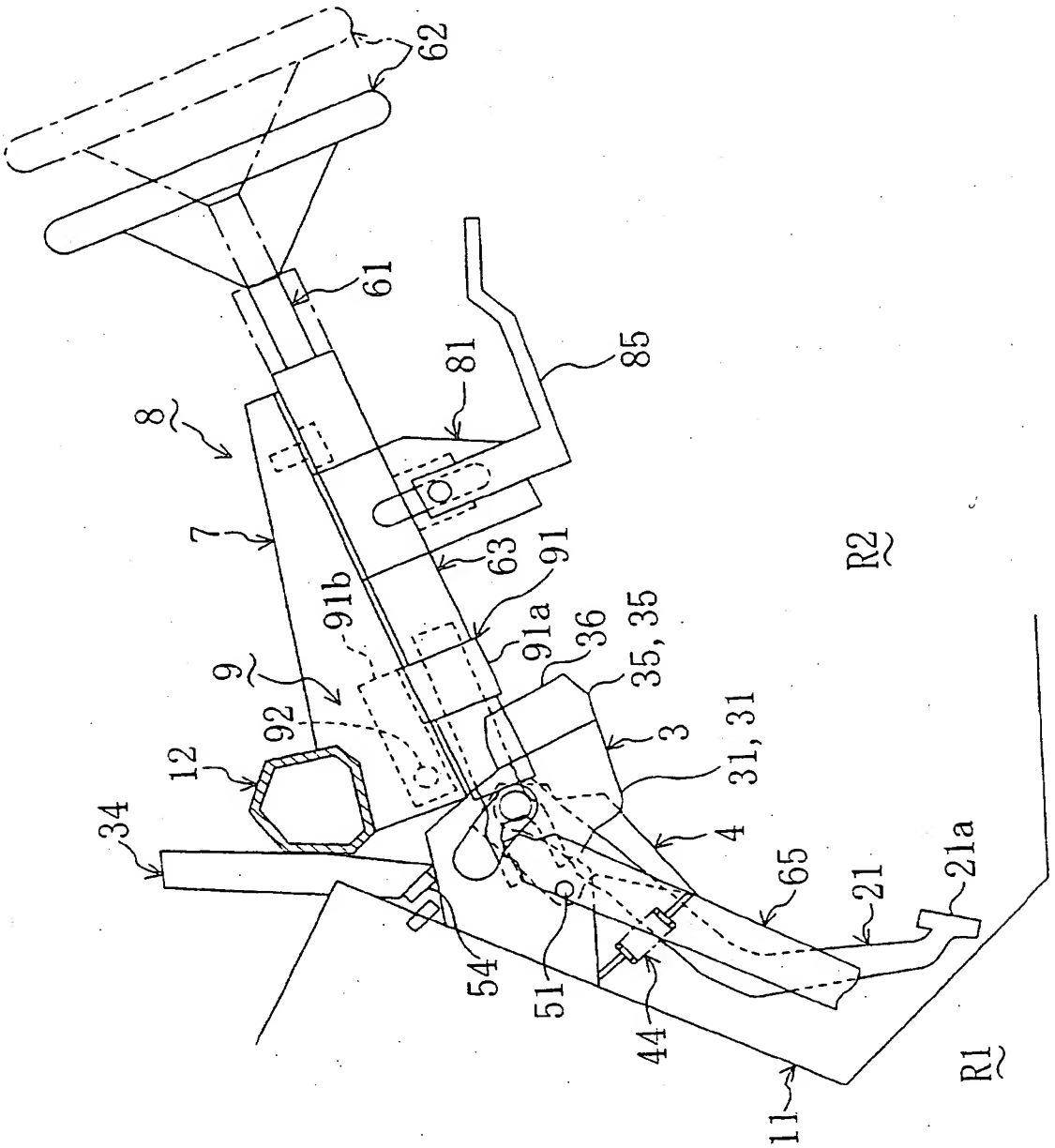

Fig. 7

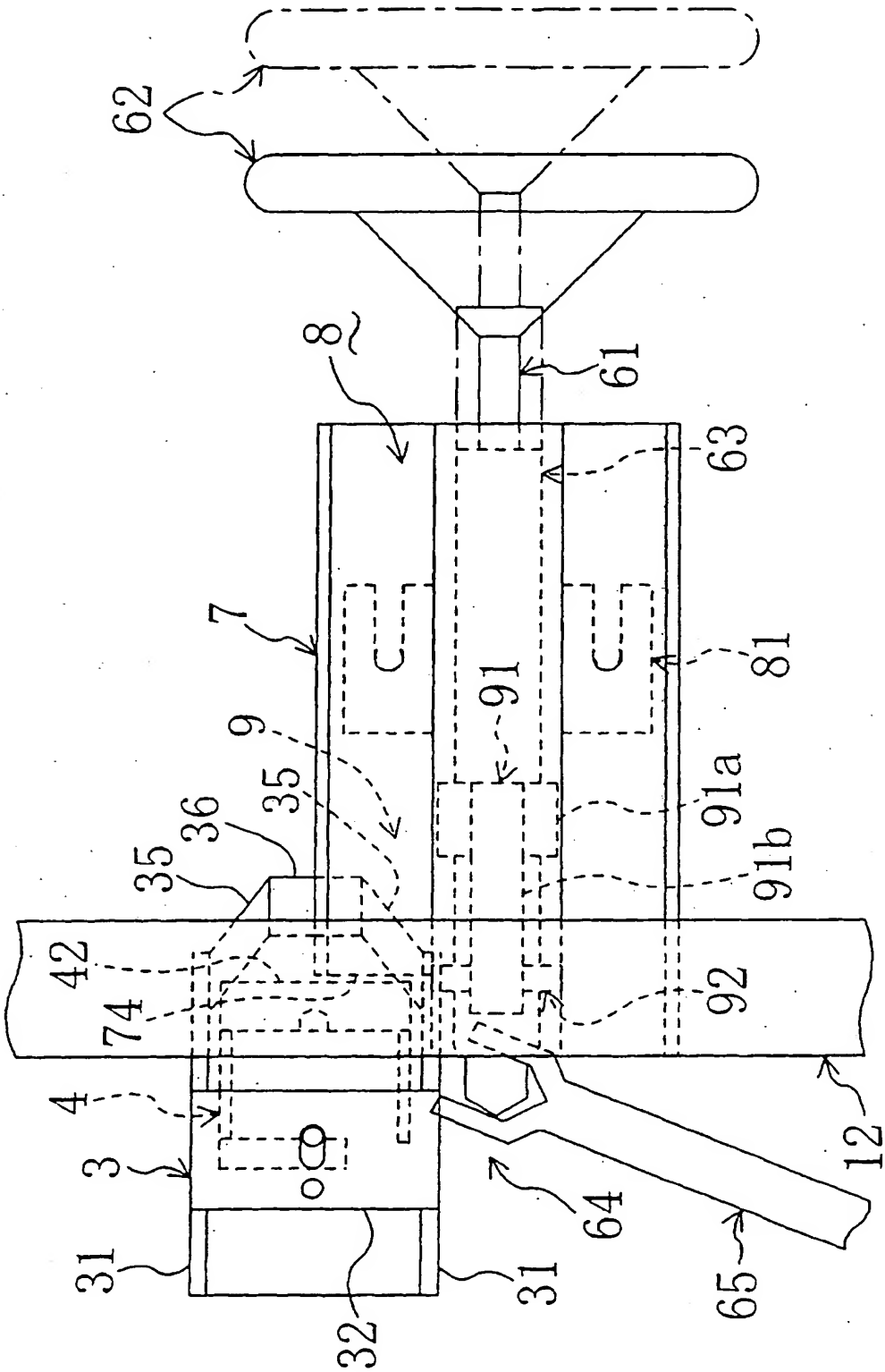

Fig. 8